therefore quite possible that hybridizing goes on between typical *simplex* and typical *tricarinata,* so that all possible mutations or forms or varieties are to be found. I, for one, will regard *Valvata simplex* Gould as a species, variable, of course, as all species are more or less variable, even as the human race is variable. For, if naturalists were to "subspeciesize" the human race as friend Baker has the fresh water mollusca of his tramping ground, we would have not only Homo sapiens auct., but also Homo sapiens villosus and Homo sapiens calvescens, according to whether we are football players or belong with bald heads in the front row.

SOME HABITS OF A CUBAN SNAIL, POLYMITA PICTA BORN

BY E. A. ANDREWS
Johns Hopkins University

Some 54 individuals of the "painted snail" only one to one and a half centimeters in diameter and immature, brought from Cuba by Mr. d'Alte Welch, were kept in a deep glass jar of six liters capacity and with both flat and curved sides, covered but ventilated, kept moist by wet paper toweling, from May to October, 1931, with attempts to feed them upon various fruits and vegetables as well as wood green with pleurococcus, yeast smears, honey, mixtures of precipitated chalk glucose and dextrine, as well as fragments of Florida oolite for source of lime.

Faeces showed no pleurococcus but some other green cells as well as towel paper fibers cut short but not digested, with also some rotifers, ciliata and many nemas, and occasional denticles from the lingual ribbon.

Mortality was great; some contained parasites, others apparently received too scanty food: only five survived into October. However, observations from July 9th to September 6th showed that under the above conditions these snails had certain marked habits both in the jar and also when placed upon trees in the grounds, in Baltimore, Md. The

animals showed but a very limited period of activity each twenty-four hours, moving about for only a few hours, as a rule.

Activity was seen as actual locomotion and inferred from change of position, when not actually under observation. While some few individuals did move about in the night and at all daylight hours, the rule was that no snails moved in the night nor in the daylight period except in the early morning. Conversely while most of the snails were active in the early morning some few were then at rest. The rest period continued on during the night till about five a. m. when activity began and lasted only till about eight a. m. when rest came again.

On different days with temperatures varying from 60-82° F. in the morning and from 68-92° in the afternoon, and with different states of weather, snails became active soon after 4 a. m. rarely, or not till 6 a. m. but generally very near 5 a. m. The return to rest followed 8 a. m. and might not be till 9 or even 10 a. m. Very rarely were any active in late forenoon or night. This matinal activity is perhaps the more striking in its limitation as the contrast is so great between habit and locomotion.

At rest the snail's foot is shrunken till but a very small part of it, as a rounded area of few millimeters extent, remains in contact with the glass or other substrate, nothing showing outside the boundary of the shell, as head and antennae are drawn in; but the foot is not quite the only means of attachment, since there may be a delicate transparent pellicle of secretion stretched from the shell all round about across to the substrate, leaving the foot at the center of this circular attachment.

Thus attached, the snail remains horizontal or vertical, upside down frequently, on most any surface, but not upon the fine wire net that supplied ventilation. Upon a tree the snails rested on the under side of leaflets, or upon stems. Pulled or shaken loose, or when wetted as by rain, such resting snails may quickly pass into active locomotion. Normally from internal conditions they slowly protrude head

and antennae, elongate the foot, and finally move forward, the pellicle disappearing.

The fully active animal travels with speed and great sure-footedness, advancing some three feet in half an hour, its long almost cylindrical foot stretched out to a very fine point behind and its greatly elongated tentacles with large terminal eyes and feelers reaching out far in advance. In this svelte creature the shagreen skin of velvet blackness over foot, head and mantle stands out in pleasing contrast to the shell of creamy white, canary yellow or bright red with longitudinal bands of white and dark; well called the painted snail. Its movements are graceful, rising up from the substratum, the head and forebody may stretch far out in advance till but the hindpart is attached, or the body may arch upward in a long loop leaving but the ends attached. On black locust trees with compound leaves the snail reaching out for side branches and leaves actually passed across large spaces, finding a new leaflet with its anterior end, attaching this end and then drawing itself together till both leaflets were near together and so passing over from one to the other, without hesitation or any falling.

Only when many were on the same suspended stick and climbed upward reaching out laterally, as for side branches, did they ever fall off and then because each crawling out upon others there resulted clumps of five or six all supported by the foot of the undermost, which finally no longer withstood the strain, so that the whole complex fell off.

Their acrobatic skill and adaptedness in climbing was well shown when one climbed up several inches on a silk wrapped wire only .4 mm. in diameter and then turned and came down again without falling from this substrate so much more narrow than its foot width; as if walking a tight rope vertically up and down.

A marked illustration of the climbing ability as well as the strength of the urge to go toward the light shown by *Polymita picta* was seen when one kept alone on an island of stone and bark in a large aquarium 75 cm. by 44 cm. by 42 cm. repeatedly passed off the island across a space of 35 mm.

over water to the glass on the side toward the light.

When observed this snail spent some half hour walking back and forth near the edge of the stone island, occasionally retreating from and coming again to the edge, exploring the air with its eye stalks stretched 16 mm. long, waving them and bending them singly and in unison, but never touching anything solid with them. Finally the animal reached out straight across the narrowest part of the space between stone and glass, 35 mm., and about as much above the water, that made a moat around the island. While the tentacles with eyes did not touch the glass they apparently gave information of its presence till the extreme tip of the end of the foot stretched far enough to touch the glass, to which it adhered, and the animal made an elongated bridge across the chasm with only the last few mm. of body sticking to the stone and supporting the entire weight, horizontally, over to the glass. Then, rapidly the head end of the foot, glided up the glass as the rear end let go from the stone and slowly passed across the space to continue the forward movement up the glass. Crawling thus on glass the animal measured 32 mm. but had stretched itself across a space of 35 mm., while its shell measured but 17 mm. in diameter.

Locomotion seemed often influenced by gravity: resting generally on the lid or upper parts of the jar the snails aroused, went downward and then in all directions, as searching for food, but eventually crawled upward again before coming to rest. On a tree they proceeded several feet upward and outward, but came to rest under some leaflet where they were remarkably inconspicuous and hard to locate in spite of their light colored shells.

While thus apparently alternating in responses to gravity negatively and positively the marked response was toward light: phototropic response. Kept some four meters from the north windows the snails, with some few exceptions, always came to rest on the face of the jar toward the window. Kept in a room with windows open to the east, south and north but near a blank wall on the west, the snails came to rest on the east face and edge of the jar.

More detailed observations made were as follows: sixty-five observations from July 13 to September 6 showed generally most snails on the east and least on the west with often some north and south, yielding such relative counts as N. 6, S. 3, E. 14, W. 3. When the sums of all these counts were taken, they were N. 266, S. 240, E. 430, and W. 169. An average of these readings would be N. 4.09, S. 3.69, E. 6.06, and W. 2.60 and the range was N. (14-0), S. (11-0), E. (17-0) and W. 8-0).

That the light from the north window seemed more effective than that from the south may be referred to the time of day when the snails are active, for as the sun moved to the south the snails went to rest when the north sky was still most brilliantly illuminated.

The response of the snails to light was also evident when an opaque screen was placed all about the jar except on the west side and at a time, 7.30 a. m., when the snails were actively moving about; then at 9.45 fifteen of the twenty-five snails had come to rest on the west side, so usually avoided, while the other ten were scattered about at rest.

Not only in the jar were the snails responsive to light but also when left several days and nights upon a black locust tree. Here they were found resting in the night and in the day except soon after sunrise for a few hours only, when they crawled about over the twigs and leaves. However, a shower even as late as 7.30 p. m. did rouse them into activity just as wetting them in the jar did.

Since the snails became active soon after sunrise some experiments were made to determine if it was the stimulus of oncoming light which was needed to rouse the resting snails. The jar containing the snails was put into an opaque carton with cover and this placed in a closet. When removed the positions of the snails showed that locomotion had taken place in the dark.

Five repeated experiments in July and August showed the following: Kept in complete darkness all night but few of the snails moved before five to six a. m., but then many were active in darkness at seven a. m. Snails in darkness went to

rest from eight to nine a. m. In going to rest in darkness the snails did not show preference for any side of the jar but were scattered about. In darkness snails become geotropic and went down to search about as if for food.

Thus change from darkness to light is not necessary to rouse the snails from rest to activity in the early morning hours but some internal factors seem involved. Did changes in temperature and consequently in saturation of moisture of air bring about matinal resumption of activity? In room constantly open by three windows temperatures changed with those outside, following them, not attaining as high maximum nor as low minimum. Snails aroused when temperatures were rising but they went to rest when temperatures were still rising and remained at rest when temperatures dropped in the evening. Moreover, the time of rousing was not that of lowest temperatures and most saturation. And in the closed carton the moisture conditions probably varied little. May not innate habits of feeding and resting and metabolic rhythms activate rather independent of outside stimuli?

The snails matinal arousing followed the songs of several wild birds welcoming the day. While Allard[1] shows such songs to be responses to the sun about to rise yet he concedes that the actual awakening of these birds takes place before the first morning song. This awakening may be compared with that of the above snails and both referred to the culmination of metabolic rhythms started long prior to the light of today.

AN OVERLOOKED ARCA FROM SOUTHERN CALIFORNIA

BY A. M. STRONG

Dr. Bartsch in the Proc. U. S. National Museum, Vol. 80, Art. 9, p. 2, which has just been received, describes a new species of *Acar* from Southern California, under the name of

[1] Allard, H. A. The first morning song of some birds of Washington, D. C. and its relation to light. American Naturalist LXIV, 1930.